

REMARKS

This application has been reviewed in light of the Office Action dated December 23, 2005. Claims 1-19 and 29 are pending in the application. By the present amendment, claims 1 and 10 have been amended. Claim 29 has been introduced. No new matter has been added. The Examiner's reconsideration of the rejection in view of the amendment and the following remarks is respectfully requested.

Applicant submits a Request for Continued Examination (RCE) herewith and respectfully requests entry and consideration of the present claims.

By the Office Action, claims 1-2, 8-10 and 16-19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application No. 2001/0043078 to Kantz et al. (hereinafter Kantz) in view of U.S. Patent Application No. 2004/0046585.1 to Kamieniecki et al. (hereinafter Kamieniecki).

The Applicants respectfully disagree with the rejection.

Kantz is directed to a built-in test unit which includes a solar cell to provide power to the testing function. The built-in test procedure includes writing data to data elements and then reading the data to determine failures. The built-in test can only be performed on a completed memory device. The test process of Kantz is useless for in-process measurements. If for example, in forming a metal layer for the memory cell a processing error occurred, Kantz would not be able to determine any failure until the completed memory devices were available. This defeats one of the stated purposes of the present invention which is to try to determine faults early in the process to reduce cost as a result of faults discovered after the entire process has been completed.

In Kantz, the solar cell is an additional feature which is added to the completed device or formed with the device. (It is not clear which). The solar cell is to attempt to save time and money on testing (see e.g., paragraph 5 of Kantz). The memory cells of Kantz are fully manufactured, and instead of being powered by test pins the circuits are powered by solar energy. The stated purpose of Kantz is that by providing a solar cell self test, many cells can be tested in parallel without the use of mechanical needle pins. (See, e.g., page 1, paragraphs, [0004], [0007] and [0008]). Testing fully fabricated devices is very much different from measuring characteristics of a device while the device is being built. There may not be a full circuit to test or features which would readily enable testing. While Kantz teaches a solar cell type energy source, Kantz fails to teach or suggest many of the elements of the present claims.

The present invention is directed to a manufacturing tool that permits testing of characteristics of a device during processing. So, for example, after a metal deposition, the metal may be tested to determine if the process was properly performed. Advantageously, the present invention is not intrusive. The components used for testing do not alter the design of other chips on a wafer. Instead, the measurement device is formed on a designated chip or in the kerf area on the same substrate as the product IC chips. In addition, choices can be made during future process steps that could remedy problems that may have been measured early in the process.

Claim 1 of the present invention now recites: a system for measuring circuits on an integrated circuit substrate during fabrication, comprising:

a measurement circuit formed on the integrated circuit substrate which measures at least one characteristic of an integrated circuit prior to the integrated circuit being completely fabricated,

the measurement circuit comprising a power transfer device including a power transfer component, which receives energy from a source where the source does not make physical contact with the integrated circuit substrate to transfer power to the measurement circuit, the measurement circuit including components that mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate.

The measurement circuit of the present invention is not formed on the product integrated circuit chips, but is formed separately and on the same substrate (See e.g., FIG. 1 and claim 1 of the present invention) so as to experience the same processing parameters.

Kantz includes memory chips, each having their own solar cell so that the chips may perform a self-test. The chip has been completely manufactured and the solar cell is incorporated into the chip itself taking up valuable real estate and affecting the overall design. The solar cell is provided for checking the memory array by writing data in a fashion that is performed by normal memory device operations on a completed chip. Kantz does not measure at least one characteristic of an integrated circuit prior to the integrated circuit being completely fabricated. Instead Kantz, performs a built-in test on completely function memory devices to determine if an input memory pattern is returned. Kantz uses redundancies to enable memory arrays to account for memory cell failures. The system of Kantz uses up chip area in providing redundant memory cells and arrays in dealing with failures. This is in direct contrast to the present invention which makes corrections for problems prior to the formation of the completed device.

Kantz fails to disclose or suggest at least a system for measuring circuits on an integrated circuit substrate during fabrication, including a measurement circuit formed on the integrated

circuit substrate which measures at least one characteristic of an integrated circuit prior to the integrated circuit being completely fabricated, ... the measurement circuit including components that mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate.

Kantz does not disclose or suggest a measurement circuit that includes components that mirror behavior of the integrated circuit to measure and provide information about processing steps to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate.

Kamieniecki fails to cure the deficiencies of Kantz.

Kamieniecki is directed to an in-process system that measures light reflected from a surface of a substrate. Kamieniecki is directed to measuring the dopant properties by exposing the surface of the substrate to a particular wavelength and frequency of light. A photovoltage is induced on the surface of the substrate which is measured by considering the properties of the reflected light (see, e.g., paragraphs [0040] and [0041] of Kamieniecki). Kamieniecki fails to disclose or suggest at least a system for measuring circuits on an integrated circuit substrate during fabrication, including a measurement circuit formed on the integrated circuit substrate which measures at least one characteristic of an integrated circuit prior to the integrated circuit being completely fabricated, ... the measurement circuit including components that mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate.

No measurement circuit is provided on the substrate in Kamieniecki (see e.g., paragraphs,

[0040] and [0041]). Therefore, no measurement circuit is present which includes components that mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate.

The cited combination of Kantz and Kamieniecki, fails to disclose or suggest the present invention as claimed. Claim 1 has been amended to further clarify the present invention over the cited art. Nowhere in Kantz and/or Kamieniecki is a measurement circuit including components that mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the integrated circuit substrate, disclosed or suggested.

Even if, *arguendo* these references are properly combined, the combination does not provide a measurement circuit which is on the wafer and includes components used to mirror behavior of the integrated circuit so that process parameters are measured for the components to provide information about processing steps. Kantz provides actual circuits which are actually tested and provide data on a completely fabricated circuit. Kamieniecki provides no circuits but measures a reflective effect to determine doping levels of a wafer. The combination of these references does not teach or suggest all of the claimed elements in claim 1 and 10.

Claim 10 includes similar recitations as in claim 1. Claim 10 recites, *inter alia*, a system for measuring circuits on an integrated circuit substrate, including a semiconductor wafer including a plurality of chips, a measurement circuit formed on at least one of the chips, the measurement circuit configured to measure at least one characteristic of a partially fabricated integrated circuit, the measurement circuit including a power transfer component which receives

energy from a source where the source does not make physical contact with the semiconductor wafer to transfer power to the measurement circuit, the measurement circuit including components that mirror behavior of the partially fabricated integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the wafer, and a test device including the source, which delivers energy to the power transfer component of the measurement circuit when in alignment with the power transfer component.

Claim 10 has been amended to further clarify the present invention. As stated with reference to claim 1, Kantz and/or Kamieniecki, taken alone or in combination, fail to disclose or suggest the measurement circuit as claimed in claim 10. Claim 10 recites, *inter alia*, that the measurement circuit includes a power transfer component which receives energy from a source where the source does not make physical contact with the semiconductor wafer to transfer power to the measurement circuit. The measurement circuit includes components that mirror behavior of the partially fabricated integrated circuit so that process parameters are measured for the components to provide information about processing steps and to determine actions to remedy problems prior to completing fabrication of integrated circuits on the wafer. Neither Kantz and/or Kamieniecki disclose or suggest such a measurement circuit.

In addition, Claim 10 includes a test device that has the source and provides energy when in alignment with a power transfer component. Kantz and Kamieniecki do not include a test device which delivers energy to the power transfer component of the measurement circuit when in alignment with the power transfer component. Kantz shines light but does not disclose or suggest aligning the energy with a power transfer component. In fact, the light energy in Kantz is specifically described to enable/activate multiple devices in parallel. No alignment is disclosed.

Further, Kamieniecki discloses a probe arrangement that aligns a wafer with the light energy, but does not disclose or suggest a power transfer component on the wafer, nor is the power transfer component aligned to the power source. This is because there is no measurement circuit or power transfer component on the wafer. Kamieniecki directs light on the wafer and measures the reflected light without powering any device or system on the wafer.

Since Kantz and/or Kamieniecki fail to disclose or suggest all elements of the present invention, claims 1 and 10 are believed to be in condition for allowance for at least the reasons stated. Claims dependent from claims 1 and 10 are also believed to be in condition for allowance at least due to their dependencies from claims 1 and 10. The dependent claims are believed to be allowable for other reasons as well.

For example, claim 17 recites that the test device includes a thin film dielectric membrane having the source mounted thereon, and claim 18 recites that the test device includes a probe ring. While the Examiner refers to element 12 of FIG. 5A of Kantz to attempt to show that these elements are disclosed, element 12 of Kantz is a radiation absorption layer that is disposed between the substrate and the radiation source to prevent charge carrier generation. Kantz is silent as to whether the layer is a thin film, a membrane, a dielectric, etc. There is no disclosure or suggestion that layer 12 of Kantz teaches or suggests that the test device includes a thin film dielectric membrane having the source mounted thereon or that the test device includes a probe ring. These elements are not disclosed or suggested by any of the cited art. Reconsideration of the rejection is earnestly solicited.

By the Office Action, claims 3, 5, 7, 11, 13 and 15 stand rejected under 35 U.S.C. §103(a) as being anticipated by Kantz in view of Kamieniecki and further in view of U.S. Patent No. 6,787,801 to Fischer et al. (hereinafter Fischer).

The Applicant respectfully disagrees with the rejection since Fischer fails to cure the deficiencies of Kantz and Kamieniecki as set forth above. Claims 3, 5, 7, 11, 13 and 15 are therefore believed to be in condition for allowance for at least the above mentioned reasons. Reconsideration is respectfully requested.

By the Office Action, claims 4 and 12 stand rejected under 35 U.S.C. §103(a) as being anticipated by Kantz in view of Kamieniecki and further in view of U.S. Patent No. 6,906,495 to Cheng et al. (hereinafter Cheng).

The Applicant respectfully disagrees with the rejection since Cheng fails to cure the deficiencies of Kantz and Kamieniecki as set forth above. Claims 4 and 12 are therefore believed to be in condition for allowance for at least the above mentioned reasons. Reconsideration is respectfully requested.

By the Office Action, claims 6 and 14 stand rejected under 35 U.S.C. §103(a) as being anticipated by Kantz in view of Kamieniecki and further in view of U.S. Patent Application No. 2002/0047722 to Cook et al. (hereinafter Cook).


The Applicant respectfully disagrees with the rejection since Cook fails to cure the deficiencies of Kantz and Kamieniecki as set forth above. Claims 6 and 14 are therefore believed to be in condition for allowance for at least the above mentioned reasons. Reconsideration is respectfully requested.

In view of the foregoing amendments and remarks, it is respectfully submitted that all the claims now pending in the application are in condition for allowance. Early and favorable reconsideration of the case is respectfully requested. The Examiner is invited to contact the undersigned to discuss any remaining issues. A telephone conference would be beneficial to advance prosecution of this case.

It is believed that no additional fees or charges are currently due. However, in the event that any additional fees or charges are required at this time in connection with the application, they may be charged to applicant's IBM Deposit Account No. 50-0510.

Respectfully submitted,

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